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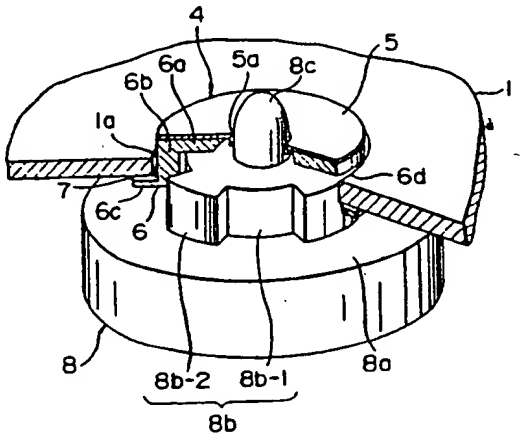
(54) Method of producing optical disk, jig for carrying out the method, and optical disk produced by the method.

(57) According to a method of producing an optical disk, comprising the steps of providing a jig having a cylindrical portion and a center pin formed on said cylindrical portion coaxially therewith; providing a transparent substrate having a reference hole formed therein at its central portion and disposed coaxially with an imaginary center of beam-tracking tracks, on the substrate, constituted by preformed pits and projections which tracks are spaced at predetermined intervals radially outwardly of the reference hole; fitting said cylindrical portion of the jig into the reference hole in the transparent substrate; and inserting the center pin of said jig into a spindle hole, formed in a spindle hole-containing member, against movement relative to the spindle hole, and subsequently securing the spindle hole-containing member to a central portion of the transparent substrate while keeping the relative position thereof the spindle hole being smaller in diameter than the reference hole in the transparent substrate, concentricity of the reference hole and the spindle hole can be easily attained.

FIG. 1



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SUMMARY OF THE INVENTION

With the above deficiencies in view, it is an object of this invention to provide a method capable of producing optical disks stable in quality efficiently on a mass-production basis, and to provide a jig used for performing such a method as well as the optical disk produced thereby.

According to a first aspect of the present invention, there is provided a method of producing an optical disk, comprising the steps of:
providing a jig having a cylindrical portion and a center pin formed on the cylindrical portion coaxially therewith;
providing a transparent substrate having a reference hole formed therein at its central portion and disposed coaxially with an imaginary center of beam-tracking tracks, on the substrate, constituted by preformed pits and projections which tracks are spaced at predetermined intervals radially outwardly of the reference hole;
fitting the cylindrical portion of the jig into the reference hole in the transparent substrate; and
inserting the center pin of the jig into a spindle hole, formed in a spindle hole-containing member, against movement relative to the spindle hole, and subsequently securing the spindle hole-containing member to a central portion of the transparent substrate while keeping relative positions thereof, the spindle hole being smaller in diameter than the reference hole in the transparent substrate.

According to a second aspect of the present invention, there is provided a jig for assembling an optical disk includes:
a cylindrical portion adapted to be fitted in a registration reference hole formed in a transparent substrate at its central portion, the transparent substrate having beam-tracking tracks of preformed pits and projections which tracks are spaced at predetermined intervals radially outwardly of the reference hole and are concentrical therewith; and
a center pin formed integrally on the cylindrical portion coaxially therewith, the center pin being adapted to be inserted into a spindle hole formed in a spindle hole-containing member at a central portion thereof.

According to a third aspect of the present invention, there is provided an optical disk comprising:
a transparent substrate having a registration reference hole formed therein at its central portion, the transparent substrate having beam-tracking tracks of preformed pits and projections which tracks are spaced at predetermined intervals radially outwardly of the reference hole and are concentrical therewith; and
a spindle hole-containing member having a spindle hole smaller in diameter than the reference hole in the transparent substrate, the spindle hole-containing member being positioned relative to the transparent substrate by means of a jig in such a manner that the axis of rotation of the spindle hole is aligned with the axis of the reference hole disposed coaxially with a tracking center of the optical disk, and the spindle hole-containing member being fixedly secured to the transparent substrate.

The transparent substrate and the spindle hole-containing member are set or positioned on the jig having the cylindrical portion and the center pin coaxially formed integrally therewith, so that the imaginary center of the beam-tracking tracks of pits and projections is automatically aligned with the center or axis of the spindle hole in the spindle hole-containing member. Therefore, a high mass-production efficiency is achieved, and the quality of the optical disk can be made stable.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantageous effects will be made clearer from description of preferred embodiments referring to attached drawings in which:

Fig. 1 is a partly-broken, perspective view of an optical disk produced by a method according to a first embodiment of the present invention, showing the manner in which an optical disk substrate and a center hub are registered or positioned relative to each other, using an assembling jig;

Fig. 2 is an exploded perspective view, showing the optical disk substrate, the center hub and the jig;

Fig. 3 is an enlarged perspective view of the center hub;

Fig. 4 is a sectional view of the optical disk according to the first embodiment;

Fig. 5 is a sectional view of a second embodiment of an optical disk of the present invention;

Fig. 6 is a perspective view of a modified center hub;

Fig. 6A is a partly-broken perspective view of a modified optical disk having the center hubs of Fig. 6;

Fig. 7 is a perspective view of a modified magnetic plate;

Fig. 8 is a sectional view showing a third embodiment of the present invention;

Fig. 9 is a plan view of an optical disk cartridge containing a modified optical disk (fourth embodiment of the invention), having a shutter in its closed condition;

Fig. 10 is a view similar to Fig. 9, but having the shutter in its open condition;

Fig. 11 is a sectional view of the optical disk

peripheral surface of the reference hole 1a and the outer peripheral surface of the cylindrical portion 6b.

As shown in Fig. 4, the flange 6c of the holder 6 is fixedly secured or bonded by an adhesive 7 to that side of the transparent substrate 1 on which the recording layer 2 is formed. With this construction, when the optical disk is set on the spindle hub of the disk drive device, a magnetic attractive force produced by a permanent magnet of this spindle hub acts on the magnetic plate 5 in such a manner as to urge the transparent substrate 1 toward the bonding surface of the center hub 4 (i.e., the flange 6c), thereby eliminating the possibility that the bonding surfaces of the two are separated from each other.

For registering the transparent substrate 1 with the center hub 4 and for integrally connecting them together, a registration jig 8 shown in Figs. 1 and 2 is used. The jig 8 is made of a wear-resistant material such as stainless steel (SUS 304 or ferrite-type SUS). The jig 8 has a base portion 8a, and a short cylindrical portion 8b formed on the base portion 8a, and a center pin 8c formed on the cylindrical portion 8b. The central axis of the cylindrical portion 8b is precisely aligned with the central axis of the center pin 8c, and their outer peripheral surfaces are precisely finished into a true circular shape.

As shown in Fig. 2, the outer diameter d3 of the cylindrical portion 8b is substantially equal to the diameter d4 of the reference hole 1a in the transparent substrate 1, and the outer diameter d1 of the center pin 8c is equal to the diameter d2 of the spindle hole 5a in the magnetic plate 5.

A plurality of (four in this embodiment) fan-shaped notches 8b-1 are formed or cut in the outer peripheral portion of the cylindrical portion 8b, and are circumferentially spaced from one another at equal intervals, so that a plurality of (four in this embodiment) fan-shaped projections 8b-2 are provided. The fan-shaped projections 8b-2 are so arranged as to correspond respectively to the notches 6d in the cylindrical portion 6b of the holder 6, so that the projections 8b-2 can be fitted in the notches 6d, respectively.

When the transparent substrate 1 and the center hub 4 are to be adhesively bonded together, the adhesive 7, such as an ultraviolet ray-curing adhesive, an epoxy-type adhesive and a urethane-type adhesive, is beforehand coated uniformly on the upper surface of the flange 6c of the holder 6, as indicated by hatching in Fig. 2. Then, the center pin 8c of the jig 8 is inserted into the spindle hole 5a of the hub 4 (d1 = d2), and at the same time the fan-shaped projections 8b-2 of the jig 8 are inserted respectively into the notches 6d formed in the cylindrical portion 6b of the holder 6, thereby first setting the center hub 4 in position on the jig 8.

Then, in this condition, the cylindrical portion 6b of the center hub 4 is inserted into the reference hole 1a of the transparent substrate 1, so that that the outer peripheral surfaces of the fan-shaped projections 8b-2, exposed outwardly through the respective notches 6d in the cylindrical portion 6b and partly in the flange 6c, are brought into contact with the inner peripheral surface of the reference hole 1a (d3 = d4). Fig. 1 shows this condition in which the axis of the reference hole 1a in the transparent substrate 1 is aligned with the axis of the spindle hole 5a in the center hub 4 by the jig 8. In this condition, by curing the adhesive 7, the imaginary center of the tracks of the preformed grooves in the transparent substrate 1 is maintained precisely in alignment with the axis of the center hub 4.

Therefore, the imaginary center of the tracks of the preformed grooves does not need to be aligned with the axis of the center hub 4 by means of the conventionally-used optical measurement, and the transparent substrate 1 can be registered with the center hub 4 efficiently and accurately, thereby improving the production efficiency.

In view of dimensional irregularities of the outer diameter of the cylindrical portion 6b of the holder 6, dimensional irregularities of the diameter of the reference hole 1a of the transparent substrate 1 (those irregularities are unavoidable in the manufacture) and burrs formed on the peripheral edges of the reference hole 1a and the cylindrical portion 6b, it has been confirmed through experiment that the outer diameter of the cylindrical portion 6b should preferably be smaller than the diameter of the reference hole 1a by at least 0.05 mm, and more preferably should be smaller by at least 0.1 mm. In this embodiment, the outer diameter of the cylindrical portion 6b is 0.06 mm smaller than the diameter of the reference hole 1a.

As shown in Fig. 3, those portions of the inner periphery of the flange 6c of the holder 6 disposed immediately adjacent respectively to the notches 6d are cut or notched radially outwardly beyond the diameter of the reference hole 1a of the transparent substrate 1 so as not to interfere with the arcuate outer peripheral surfaces of the fan-shaped projections 8b-2 of the jig 8.

For precisely registering the reference hole 1a of the transparent substrate 1 with the arcuate outer peripheral surfaces of the fan-shaped projections 8b-2 of the jig 8, it has also been confirmed through experiment that it is very advantageous to effect such registration by press-fitting the reference hole 1a of the transparent substrate 1 around the arcuate outer peripheral surfaces of the fan-shaped projections 8b-2, particularly when the

hub. Fig. 14 is a bottom view of the center hub. Fig. 15 is an enlarged sectional view of a portion of the center hub in the vicinity of its spindle hole. Fig. 16 is an enlarged sectional view of an outer peripheral portion of the center hub. Fig. 17 is a plan view of an assembling jig.

The optical disk cartridge in this embodiment comprises broadly an upper case, a lower case, the optical disk, an inadvertent erasure prevention member for the recording on an A-surface of the disk, an inadvertent erasure prevention member for the recording on a B-surface of the disk, and the shutter.

A cartridge case 21 constituted by the upper and lower cases is molded of a synthetic resin such as polycarbonate, ABS resin, a mixture of polycarbonate and ABS resin, and a polypropylene. As shown in Fig. 10, a head access opening 22 of a slot-like shape is formed generally in a central portion of the cartridge case 21, this head access opening 22 being continuous with a drive shaft insertion opening. A generally left-half region of the cartridge case 21 including the head access opening 22 is slightly stepped downwardly with respect to the upper surface of the cartridge case 21 to provide a slide-guiding recessed portion 23 of a generally rectangular shape. The shutter 28 is movably provided in the slide-guiding recessed portion 23, and is always resiliently urged by a spring (not shown) in its closing direction.

An arrow mark 24 indicating the direction of insertion of the disk cartridge as well as a mark 25 indicating the side A (or the side B) is provided on that portion of the cartridge case 21 disposed adjacent to the slide-guiding recessed portion 23. Registration holes 26a and 26b composed of the combination of an oval hole and a circular hole are provided at the rear portion of the cartridge case 21 at the right and left sides thereof. The A-side inadvertent erasure prevention member 27a and the B-side inadvertent erasure prevention member 27b are provided rearwardly of the registration holes 26a and 26b, respectively, and are disposed symmetrically with respect to the central plane of the cartridge case 21, the two inadvertent erasure prevention members 27a and 27b being movable.

As shown in Fig. 11, the optical disk 29 rotatably housed in the cartridge case 21 mainly comprises transparent substrates 30 of a disk-shape each having at one side a recording layer (not shown) having tracks of fine pits and projections formed by preformed grooves or preformed pits, center hubs 31 adhesively bonded respectively to the inner peripheral portions of the two transparent substrates 30, and a pair of inner and outer peripheral spacers 33 and 34 interposed between the two transparent substrates 30 to provide an air gap 32 of a predetermined thickness. The recording layers on the two transparent substrates 30 are directed inwardly, that is, toward each other.

The center hub 31 comprises a holder 36 of a synthetic resin having substantially the same coefficient of thermal expansion as the transparent substrate 30, and a magnetic plate 37 integrally connected to the holder 36. In this embodiment, the transparent substrate 30 and the center hub 31 are both made of polycarbonate having a thermal expansion coefficient of 8×10^{-5} cm/cm/°C. The holder 36 has a radially-outwardly extending flange 35 at its outer peripheral portion, the flange 35 being adapted to be adhesively bonded to the transparent substrate 30. The magnetic plate 37 is embedded in the central portion of upper surface of the holder 36 by injection molding.

The upper surface of the magnetic plate 37 is exposed from the holder 36 so as to be disposed in opposed relation to a permanent magnet provided on a spindle hub of a disk drive device. As shown in Figs. 13 and 15, an integral inner peripheral wall 38 is formed by bending at the central portion of the magnetic plate 37, and the peripheral wall 38 defines a spindle hole (internal bore) 39 into which a center pin of the above spindle hub is adapted to be inserted. As shown in Fig. 15, a distal end portion 40 of the inner peripheral wall 38 is slightly bent radially outwardly, so that the edge of the distal end portion 40 will not be brought into direct contact with the above spindle hub and a center pin of the assembling jig. In addition, the edge of the distal end portion 40 is directed into the holder 36 to serve to prevent the magnetic plate 37 from being disengaged from the holder 36.

At least one tongue 41 depends from the outer periphery of the magnetic plate 37 (in this embodiment, there are provided three tongues 41 spaced from each other at equal or regular intervals in the direction of the circumference of the magnetic plate 37). As shown in Fig. 13, the tongues 41 are embedded in the holder 36 to serve to prevent the magnetic plate 37 from being disengaged from the holder 36. As shown in Figs. 12 and 13, a plurality of positioning holes 42 are formed through the magnetic plate 37 (in this embodiment, there are provided three positioning holes 42 circumferentially spaced from one another at equal intervals). When the holder 36 is to be injection-molded on the magnetic plate 37, the injection molding is carried out, with registration or positioning pins on a mold being fitted respectively in the positioning holes 42, so that the magnetic plate 37 is embedded in the holder 36 coaxially therewith, as later described.

In order to ensure a proper tracking during the recording and reproduction of signals, it is necessary to adhesively bond the transparent substrate 30 and the center hub 31 together in such a

In the sixth and seventh embodiments, when the magnetic plate 31 (37) is to be secured to the transparent substrate 30, the cylindrical portion 8b (more specifically, the fan-shaped projections 8b-2) of the jig 8 shown in Fig. 2 is press-fitted into the central hole or recess 48 of the transparent substrate 30, so that the center pin 8c of the jig 8 is fitted into the central hole (spindle hole) 39 of the magnetic plate 31, thus fixing magnetic plate 31 relative to the transparent substrate 30, and the magnetic plate 31 is bonded to the transparent substrate 30 by the adhesive under the thus fixed relative position.

The optical disks described above can be produced efficiently on a mass-production basis by the above-mentioned methods using the assembling jig, and the thus produced optical disks are stable in quality.

Claims

1. A method of producing an optical disk, comprising the steps of:
providing a jig having a cylindrical portion and a center pin formed on said cylindrical portion coaxially therewith;
providing a transparent substrate having a reference hole formed therein at its central portion and disposed coaxially with an imaginary center of beam-tracking tracks, on said substrate, constituted by preformed pits and projections which tracks are spaced at predetermined intervals radially outwardly of said reference hole;
fitting said cylindrical portion of said jig into said reference hole in said transparent substrate; and
inserting said center pin of said jig into a spindle hole, formed in a spindle hole-containing member, against movement relative to said spindle hole, and subsequently securing said spindle hole-containing member to a central portion of said transparent substrate while keeping relative positions thereof, said spindle hole being smaller in diameter than said reference hole in said transparent substrate.

2. A method according to claim 1, in which a plurality of notches are formed in an outer peripheral surface of said cylindrical portion of said jig.

3. A method according to claim 1, in which said cylindrical portion of said jig is press-fitted into said reference hole in said transparent substrate.

4. A jig for assembling an optical disk includes:
a cylindrical portion adapted to be fitted in a registration reference hole formed in a transparent substrate at its central portion, said transparent substrate having beam-tracking tracks of preformed pits and projections which tracks are spaced at predetermined intervals radially outwardly of said reference hole and are concentrical therewith; and
a center pin formed integrally on said cylindrical portion coaxially therewith, said center pin being adapted to be inserted into a spindle hole formed in a spindle hole-containing member at a central portion thereof.

5. A jig according to claim 4, in which said cylindrical portion and said center pin are both made of a wear-resistant material.

6. An optical disk comprising:
a transparent substrate having a registration reference hole formed therein at its central portion, said transparent substrate having beam-tracking tracks of preformed pits and projections which tracks are spaced at predetermined intervals radially outwardly of said reference hole and are concentrical therewith; and
a spindle hole-containing member having a spindle hole smaller in diameter than said reference hole in said transparent substrate, said spindle hole-containing member being positioned relative to said transparent substrate by means of a jig in such a manner that the axis of rotation of said spindle hole is aligned with the axis of said reference hole disposed coaxially with each other, and said spindle hole-containing member being secured to said transparent substrate.

7. An optical disk according to claim 6, in which said spindle hole-containing member has a cylindrical portion having notches formed therein.

8. An optical disk according to claim 7, in which said spindle hole-containing member has a radially outwardly-directed flange formed on said cylindrical portion of said spindle hole-containing member, notches being formed in said flange, so that said flange has flange sections spaced form one another by said notches.

9. An optical disk according to claim 8, in which there are provided first and second said transparent substrates disposed in opposed relation to each other, first and second said spindle hole-containing members being fixedly secured respectively to said first and second transparent substrates, said flange sections of said flange of said first spindle hole-containing member being fitted respectively in said notches in said flange of said second spindle hole-containing member whereas said flange sections of said second spindle hole-containing member are fitted in said notches in said flange of said first spindle hole-containing member, and the opposite sides of said flange sections of said flanges of said first and second spindle hole-containing members being bonded to the opposed surfaces of said first and second transparent substrates, respectively.

10. An optical disk according to claim 8, in which said spindle hole in said spindle hole-containing member is made from a magnetic material.

11. An optical disk according to claim 6, in

FIG. 1

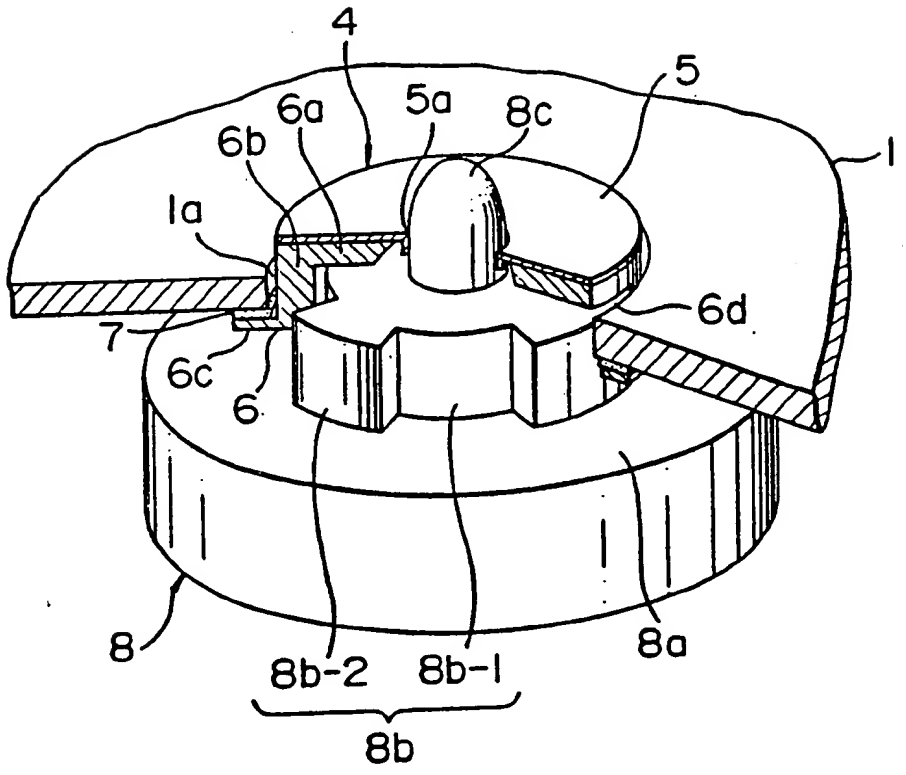


FIG. 3

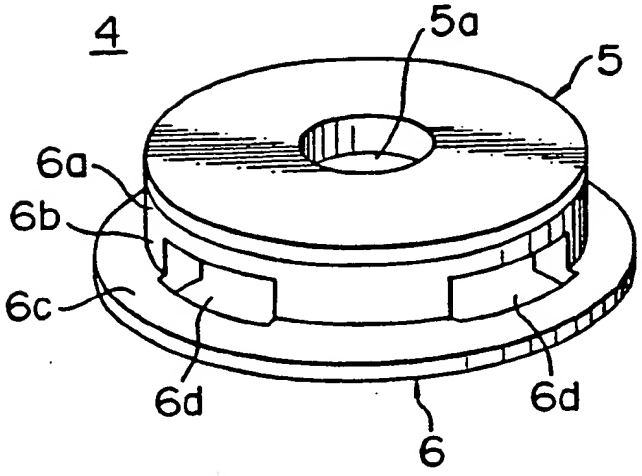


FIG. 4

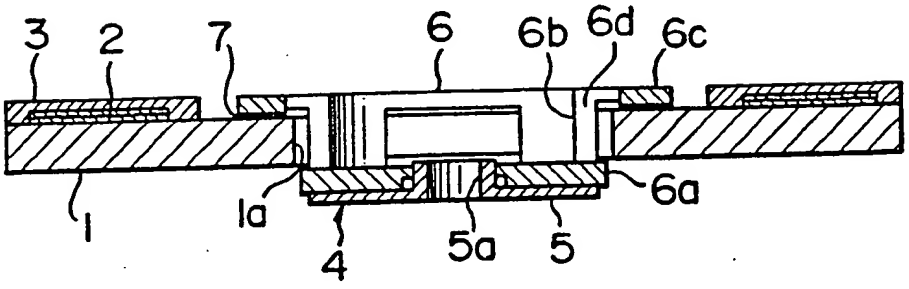


FIG. 5

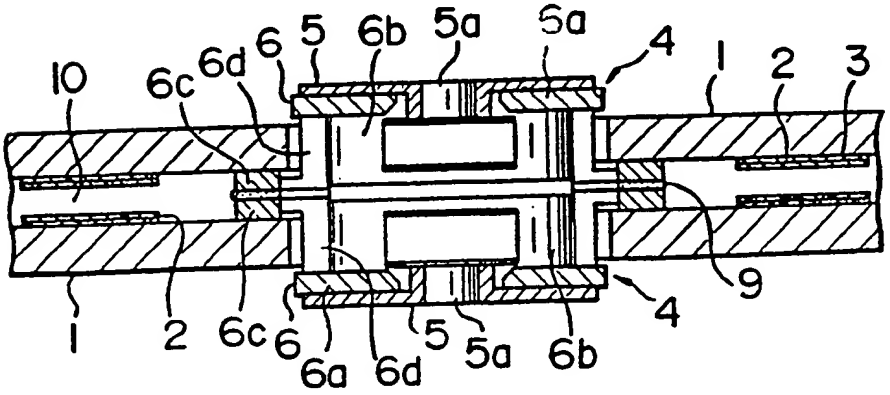


FIG. 7

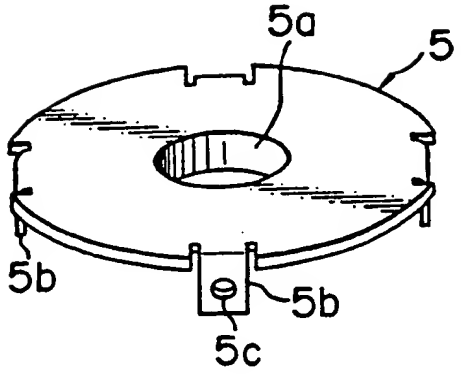


FIG. 8

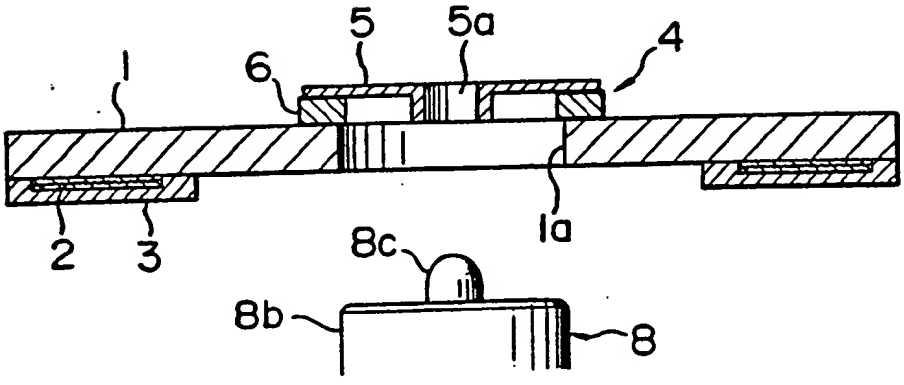


FIG. 11

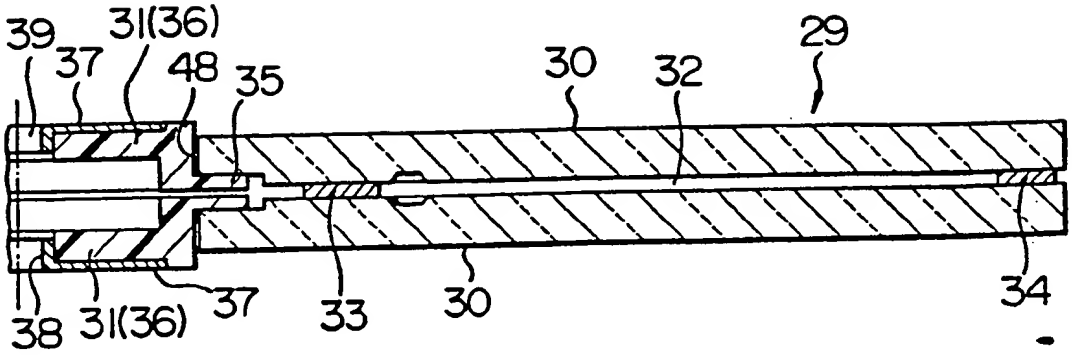


FIG. 12

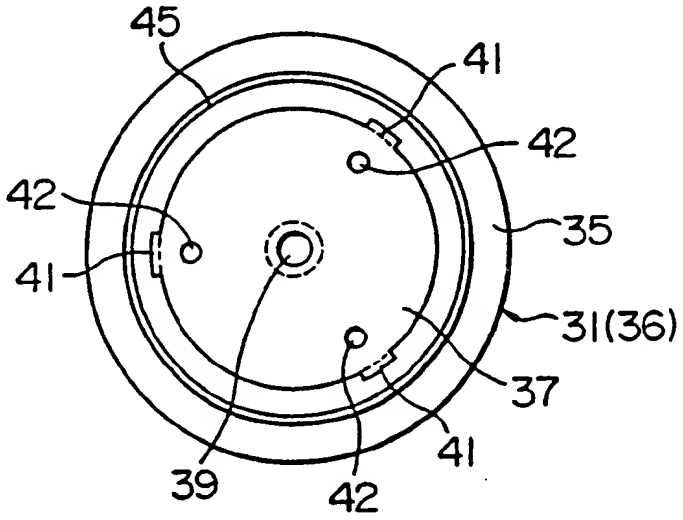


FIG. 13

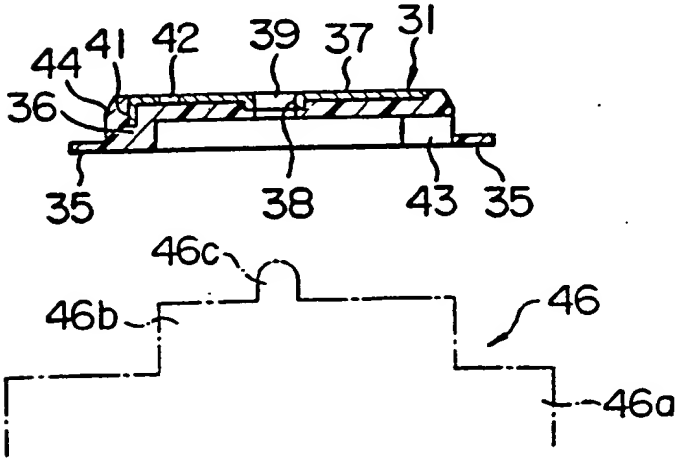


FIG. 17

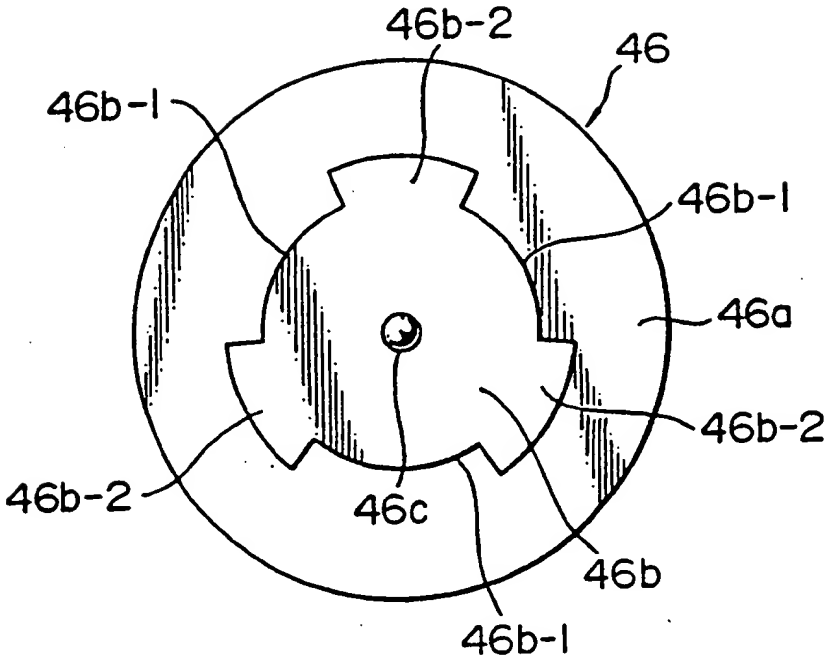


FIG. 18

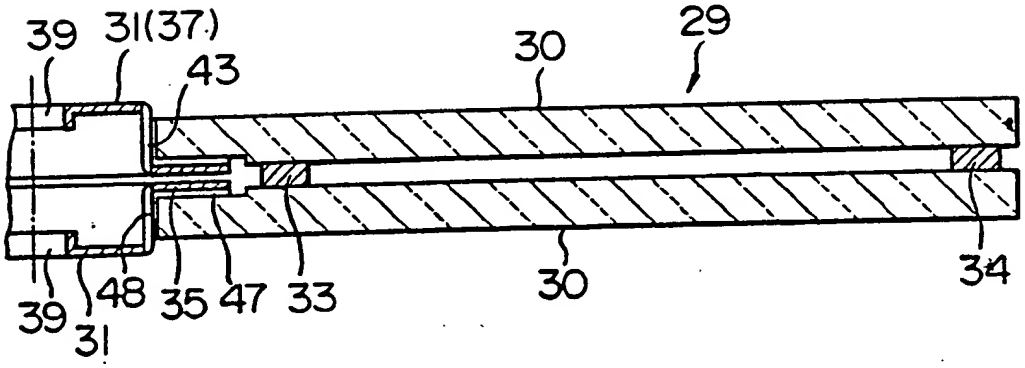
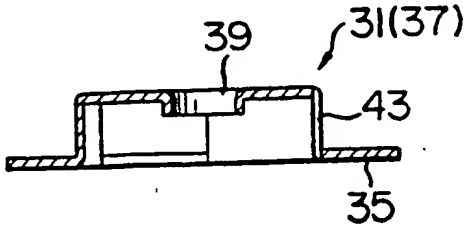


FIG. 19



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EUROPEAN SEARCH REPORT

Application number

EP 90302296.0

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl.)
X	PATENT ABSTRACTS OF JAPAN, unexamined applications, P field, vol. 11, no. 170, June 2, 1987 THE PATENT OFFICE JAPANESE GOVERNMENT page 65 P 581 * Kokai-no. 62-1 147 (HITACHI MAXELL LTD) * --	1,6	G 11 B 7/26 G 11 B 7/24
A	PATENT ABSTRACTS OF JAPAN, unexamined applications, P field, vol. 9, no. 167, July 12, 1985 THE PATENT OFFICE JAPANESE GOVERNMENT * Kokai-no. 60-43 242 (SHARP K.K.) * --	1,6	
A	EP - A1 - 0 243 517 (MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD.) * Fig. 3-16; abstract * ----	1,2,6, 7	TECHNICAL FIELDS SEARCHED (Int Cl.) G 11 B 7/00 G 11 B 5/00 G 11 B 23/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	31-05-1990	BERGER

CATEGORY OF CITED DOCUMENTS

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